REMARKS:

1) In view of the accompanying Request for Continued Examination (RCE), the Final Status of the Office Action of June 11, 2008 shall be withdrawn, and the examination shall be continued on the basis of the present claim amendments and remarks.

2) The Examiner's attention is directed to applicants' third Information Disclosure Statement being filed together with the present Response. Please consider the cited references, and return an initialed, signed and dated acknowledgment copy of the IDS Form PTO-1449 of December 11, 2008.

3) A minor correction or clarification has been made in the specification at page 2 line 3, to more-accurately describe the actual disclosure of the prior art reference being discussed therein (US Patent 6,122,965). Namely, US 6,122,965 (Seidel et al.) clearly discloses that the so-called error angle is in a range between 10° and 20° (col. 2 line 17, col. 4 line 58, and col. 6 lines 23 to 26). Thus, at most, the error angle is still less than 20° in order to be between 10° and 20°. Thus, the present amendment of the specification does not introduce any new matter, but rather merely corrects a previous erroneous discussion of the actual disclosure of the known prior art reference. Entry of the amendment is respectfully requested.

4) Prior claims 17 to 33 have been maintained without amendment. New claims 34 to 39 have been added. The new claims recite additional features supported in the original disclosure as shown in the following Table. Thus, the new claims do not introduce any new matter. Entry and consideration thereof are respectfully requested.

new claims	34	35	36	37	38	39
original support	P 2 L 3, 22; P 3 L 4 - 5; P 6 L 14 -19	P 5 L 3 -12	Cl 17; Fig. 2; P 2 L 3, 22; P 3 L 4 - 5; P 6 L 14 -19	P 2 L 3, 22; P 3 L 4 - 5; P 6 L 14 -19	P 6 L 14 -19	P 5 L 3 -12

5) Referring to pages 2 to 7 of the Office Action, the rejection of claims 17 to 33 as obvious over US Patent 5,905,203 (Flach et al.) in view of US 6,122,965 (Seidel et al.) is respectfully traversed.

Applicants' remarks distinguishing the present invention from the disclosures of Flach et al. and Seidel et al., as set forth in the prior Response of March 5, 2008, are incorporated herein by reference and reasserted.

In the first nine lines on page 3 of the Office Action, the Examiner has asserted that the present specification does not describe why a particular "offset angle" is desirable, or particularly why the "offset angle" of more than 20° is beneficial, so that providing any particular offset ratio is merely "a *matter of design choice*" within the level of ordinary skill. These assertions are respectfully traversed.

A person of ordinary skill in the art understands that providing such an offset angle makes the sensor sensitive in an additional inertial acceleration direction. For example, in a flat sensor without any offset angle, such as the sensor according to Flach et al., the horizontally extending "paddle" of the sensor is only sensitive to vertical accelerations (see Fig. 8 of Flach et al.). An acceleration in the two horizontal directions will not cause a deflection of this sensor, because the center of gravity lies in the horizontal plane of the pivot axis of the paddle. For this reason, such a flat non-offset sensor as disclosed by Flach et al. is sensitive on only one axis (see Fig. 8 and col. 3 lines 29 to 35 of Flach et al.).

On the other hand, as explained in the present specification (for example see page 7 line 13 to page 9 line 7 and Figs. 2, 3A and 3B of the present application), a sensor seismic mass with an offset angle will be sensitive not only in the vertical direction Z, but also in a horizontal direction X or Y, because a horizontal acceleration force will act on the center of gravity of the seismic mass, and its vertical offset from the horizontal pivot axis plane will cause a deflection of the seismic mass about the pivot axis due to the horizontal acceleration. Because the center of gravity is also horizontally offset from the pivot axis, therefore the sensor will also be sensitive to accelerations in the vertical direction. Thus, the offset angle makes the sensor sensitive to multi-axial accelerations.

When the offset angle is rather small, for example less than 20° as disclosed by Seidel et al., then the sensitivity and resolving ability of the sensor is also quite small with respect

to accelerations in a direction acting on the smaller offset lever arm of the offset of the center of gravity from the pivot axis. For example, in the sensor according to Seidel et al., with a small vertical offset and a rather long horizontal offset of the center of gravity from the pivot axis (see Fig. 2), giving a very small offset angle less than 20°, such a sensor is highly sensitive to vertical accelerations, but only very slightly sensitive to horizontal accelerations, because of the very small relative offset in a vertical direction.

On the other hand, the inventive acceleration sensor provides an offset angle of greater than 20°, which provides a larger sensitivity to horizontal accelerations than can be achieved according to Seidel et al. The invention preferably provides an offset angle of 45° (e.g. see dependent claim 31), which is considered the ideal case (see page 3 line 5 and page 6 lines 17 to 19 of the present specification). A 45° offset angle is ideal, because then the offset in the vertical direction and the offset in the horizontal direction are equal to one another, so that the sensor will be equally sensitive in the vertical direction and in the pertinent horizontal direction. Such equal sensitivity in both the vertical and horizontal directions simplifies the signal processing requirements, e.g. simplifies the signal processing hardware and/or software.

For the above reasons, it is apparent that the appropriate "offset angle" is **NOT** merely "*a matter of design choice*" within the discretion of a person of ordinary skill in the art. To the contrary, the offset angle directly establishes the multi-axial functionality of the sensor, and the magnitude of the offset

angle influences the multi-axial sensitivity of the sensor. Also for the above reasons, it is a great benefit to provide an offset angle of more than 20°, because this increases the secondary axis sensitivity, reduces the proportional error, and simplifies the signal processing demands. Achieving the ideal 45° offset angle provides the ideal multi-axial acceleration sensor with the same sensitivity for both the primary axis (e.g. vertical direction) and the secondary axis (e.g. horizontal direction). The prior art references did not disclose and would not have suggested such features of an offset angle greater than 20° in a sensor arrangement as recited in present claim 17, and also would not have enabled the attainment of such a large offset angle.

In the second to last paragraph on page 6 of the Office Action (regarding claim 33), the Examiner has asserted that the acceleration sensor according to Flach et al. is arranged so as to define offsets in two orthogonal directions of the center of gravity relative to the pivot axis. That assertion is respectfully traversed, with regard to both present independent claims 17 and 33. Flach et al. positions the center of gravity directly in the horizontal reference plane extending through the pivot axis. Therefore Flach et al. clearly have the center of gravity offset from the pivot axis only in the horizontal direction within the horizontal reference plane (when the sensor is undeflected at rest). There is no vertical offset. That is expressly the case, because the sensor of Flach et al. is only a single axis sensor that is purposely only sensitive to accelerations in the vertical direction. According to Flach et al., the inertial mass is a flat paddle formed by cutting-out or

structuring a wafer by etching (col. 2 lines 20 to 67, col. 3 lines 18 to 28). Such a flat panel inertial mass that lies on the same horizontal reference plane as its pivot axis will necessarily have the center of gravity also lying in this horizontal reference plane, so that the center of gravity is offset from the pivot axis only in the horizontal direction. Therefore, Flach et al. do not have any offset angle according to the present invention. It is important to recognize that the offset angle is expressly defined for the condition "when said respective inertial mass is at rest without being deflected" (lines 9 to 11 of present claim 17). In such a condition, it is absolutely clear that Flach et al. do not have any offset angle, and it is not true as asserted by the Examiner that "*Flach already comprises an undisclosed, but measurable offset angle as well*" (lines 8 and 9 of page 3 of the Office Action).

It is recognized that the acceleration sensor according to Seidel et al. has an offset angle (see Fig. 2, col. 3 lines 9 to 19, col. 4 lines 48 to 60, and col. 6 lines 1 to 5 and 18 to 23 of Seidel et al.). However, there are two important distinctions relative to the present invention, as follows.

First, Seidel et al. expressly disclose that the error angle or offset angle is in the range <u>between</u> 10° and 20°, i.e. <u>less than 20°</u>. It is also significant that the structure according to Seidel et al. is not suitable for achieving higher offset angles. As shown in Fig. 2, the construction according to Seidel et al. <u>necessarily has a relatively long horizontal offset</u> between the center of gravity and the pivot axis, and a <u>relatively small vertical offset</u> between the center of gravity

and the horizontal reference plane passing through the pivot axis. This is because the seismic mass according to Seidel et al. is a flat paddle connected by a bending beam hinge to the outer frame formed from the same flat wafer by etching (Fig. 2; col. 2 lines 18 to 28 and 55 to 61). The thinner etched **bending beam hinge** forms the pivot axis all the way at the edge of one of the seismic mass paddles, in fact **the pivot axis is displaced laterally outside of the body of the seismic mass** (see Figs. 1, 2, 4 and 5). Therefore, necessarily, the center of gravity of the seismic mass paddle is offset quite far horizontally from this pivot axis all the way to the edge of the paddle in the thinner bending beam section. Also, due to the thinness of the seismic mass paddle, the vertical offset of the center of gravity is quite small. This combination of a small vertical offset and a large horizontal offset necessarily leads to a small offset angle.

Contrary to Seidel et al., the present invention provides a seismic mass that is rather thick, compact and boxy relative to the thin paddle configuration of Seidel et al. (see Figs. 2, 3A and 3B of the present application), and especially suspends this thick boxy seismic mass from two **torsion beams** that form the **pivot axis** extending at any desired location **within the body of the seismic mass**. In other words, the bending beam hinge according to Seidel et al. necessarily positions the pivot axis outside of the body of the seismic mass. On the other hand, the torsion beam according to the present invention positions the pivot axis within the body of the seismic mass, and in fact at

any horizontally-shiftable and vertically-shiftable position within the seismic mass as desired. For this structural reason, it is possible according to the present invention to achieve any desired offset angle, which is preferably an offset angle greater than 20° and especially an ideal offset angle of 45° for the reasons discussed above. In other words, any desired vertical displacement and any desired horizontal displacement between the center of gravity and the pivot axis can be achieved in the present sensor construction, contrary to the sensor construction of Seidel et al. which is necessarily limited to small offset angles less than 20°.

Secondly, the bending beam hinge according to Seidel et al. is significantly different from the torsion beam suspension according to the present invention, and according to Flach et al. Generally, a torsional strain is much more difficult and much more complicated than a simple bending strain. For a given material, a torsional strain is also expected to be more-limited than a simple bending strain, based on the stress that can be applied to the material. Particularly, from reading Seidel et al., persons of ordinary skill in the art understood that a sensor paddle could be expected to deflect sufficiently for an offset angle of less than 20° when the sensor paddle is suspended by a bending beam hinge. Namely, it was understood that a bending beam would provide sufficient bending flexibility to provide the required degree of deflection of the sensor paddle. Also note that Seidel et al. expressly disclose that the error angle or offset angle can correspond to the displacement of the seismic mass paddle from the plane of the bending beam during

acceleration of the seismic mass, under certain circumstances (col. 6 lines 18 to 22). Contrary thereto, a person of ordinary skill in the art would expect that torsion of a torsion beam would be much more stressful and much more limiting than the simple bending of a bending beam. This is especially true if the same typical ceramic material is used to fabricate the torsion beam as the bending beam. Such ceramic materials are typically brittle and cannot exhibit or withstand high levels of strain. Thus, even from reading Seidel et al., a person of ordinary skill in the art would not have expected that an offset angle of greater than 20° could be achieved, and especially not that such a high offset angle could be achieved in connection with a torsion beam suspension, instead of a bending beam suspension.

In this regard also, the person of ordinary skill in the art would have considered that the torsion beam suspension provided by Flach et al. is only provided with a zero offset angle, i.e. no offset angle at all. Thus, further, there would have been no suggestion by the combination of Seidel et al. with Flach et al., that a torsion beam suspension would have been suitable in connection with a large offset angle of greater than 20°.

For the above reasons, a person of ordinary skill in the art considering the two references in combination would not have found a teaching, suggestion or motivation, or any common sense reason, or a predictable result that could have been expected, to combine and modify the teachings of the two references in such a manner so as to achieve the present invention.

For the above reasons, the invention of claim 17 would not have been obvious. Claims 18 to 32 are patentable already due to their dependence from claim 17.

Independent claim 33 recites that the center of gravity must be offset from the torsional pivot axis in two orthogonal directions, but does not specify that the resulting offset angle must be greater than 20°. However, for the reasons discussed above, a person of ordinary skill in the art would not have been motivated even to achieve such an offset in two orthogonal directions. Namely, Seidel et al. provide an offset in two orthogonal directions only in connection with a bending beam hinge providing a pivot axis outside of the body of the inertial mass, and not in connection with a torsion beam that establishes the pivot axis directly within the body of the inertial mass itself. On the other hand, Flach et al. provide a torsion beam to establish a pivot axis directly within the body of the inertial mass itself, but as a result do not and cannot provide an offset of the center of gravity from the pivot axis in two orthogonal directions, but rather only in one (horizontal) direction. here would have been no suggestion and no enabling disclosure of how to achieve such a combination of features.

Furthermore, present claim 33 recites that the frame of the sensor arrangement includes an outer frame as well as an inner divider frame arranged in a particular manner. The Examiner has asserted that the arrangement according to Seidel et al. includes such an outer frame and inner divider frame, so that substituting the inertial masses and frame structure of Seidel et al. for that of Flach et al. would have resulted in an arrangement like the

presently claimed outer frame and inner divider frame. However, the frame structure of Seidel et al. relates to the use of a bending beam hinge to establish each pivot axis, so that all of the hinging and pivoting of all four inertial masses is carried out from the outer frame. Namely, all of the bending beams connect the inertial masses to only the **outer** frame according to Seidel et al. There is no suggestion to suspend an inertial mass from both an outer frame and an inner divider frame. In fact, the structure of Flach et al. also involves suspending the inertial mass only from only an **outer** frame. Thus, even a combined consideration of the two references would have provided no suggestion toward suspending each inertial mass from the outer frame and from an inner divider frame. Particularly, there would have been no suggestion and no enabling disclosure of how to achieve that, and even whether the inner divider frame would be sufficiently strong to provide such suspension.

For the above reasons, the invention of present claim 33 is also patentably distinguishable over the prior art.

Accordingly, the Examiner is respectfully requested to withdraw the rejection of claims 17 to 33 as obvious over Flach et al. in view of Seidel et al.

6) New dependent claims 34 to 39 recite additional features that further distinguish the invention from the prior art. Claims 34 and 37 recite that the offset angle is at least 21°, as a clear distinction from the offset angle of Seidel et al. that is less than 20°. While the original application text did not recite the

particular number 21°, the specification did expressly explain that the offset angle or error angle is "freely adjustable or settable" for any desired angle of greater than 20°, and even an ideal angle of 45° (page 6 lines 17 to 19). Claim 38 depends from claim 33, and recites that the offset angle is 45°, similar to claim 31 depending from claim 17. Claims 35 and 39 recite that the frame, inertial masses and torsion spring elements consist of silicon. While Seidel et al. disclose that the components can consist of silicon, this emphasizes that the material is quite hard, brittle and non-strainable, so that it is surprising that a torsion beam can provide sufficient pivoting in connection with the inventive offset angle of greater than 20°. Claim 36 recites that the sensor arrangement of claim 33 must have an offset angle greater than 20°. Favorable consideration of the new claims is respectfully requested.

7). Favorable reconsideration and allowance of the application, including all present claims 17 to 39, are respectfully requested.

Respectfully submitted,

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Enclosures:
Transmittal Cover Sheet
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Form PTO-2038
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